ENVIRONMENTAL CONSTRUCTION GUIDELINES

FOR

MUNICIPAL ROAD, SEWAGE AND WATER PROJECTS

JANUARY 1987

Municipal Engineers Association

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PREFACE

This document sets out considerations for mitigating possible adverse environmental impacts from construction activities associated with municipal road, sewage and water projects. The document is an advisory one, intended to provide a reference for designers, construction supervisors and contractors. It is intended to complement the more detailed standard specifications used by municipalities for constructing these projects.

Although not a condition of approval for the Class Environmental Assessments for Municipal Roads or Municipal Sewage and Water Projects under the Environmental Assessment Act, the Ministry of the Environment and the Municipal Engineers Association agreed that it would be useful to publish advisory construction guidelines at the same time as the approved Municipal Class EA's were distributed to Ontario municipalities.

The document was prepared by representatives from the Municipal Engineers Association, in conjunction with Ministry of the Environment staff and is based largely on the Ministry of the Environment's "Environmental Considerations for Planning the Construction of Provincial Sewage and Water Projects", Fourth Edition, January, 1985, which forms Appendix VII of the Class Environmental Assessment for Provincial Sewage and Water Projects. Participation of the following individuals in the preparation of this report is acknowledged.

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The Ministry of Transportation and Communications was also consulted in preparing the roads aspect of this document and certain of their construction guidelines for roads were reviewed, including:

- "Highway Construction Practices and Potential Environmental Concerns, 1978";
- "Field Environmental Protection Concerns for Construction Staff, 1976";
- "Environmental Reference Book: Groundwater, 1985";
- "Environmental Reference Book: Noise, 1985".

Other environmental construction guidelines reviewed in preparing this document were:

- Ontario Hydro's "Construction and Site Restoration Guidelines for Transmission Facilities, 1986";
- Ministry of Natural Resources' "Environmental Quality Implementation Handbook, as revised, 1985";

- Ontario Energy Board's "Environmental Guidelines for the Construction and Operation of Pipelines in the Province of Ontario, 1984";

- Ministry of the Environment's (Water Resources Branch) "Evaluating Construction Activities Impacting on Water Resources: Guidelines for Construction of Highways and Bridges, 1984";

- Ministry of the Environment's (Water Resources Branch) "Evaluating Construction Activities Impacting on Water Resources: Transmission and Distribution Guidelines for Construction of Hydro Carbon Pipelines Crossing Water Courses, March, 1984".

Suggestions to improve the document or to incorporate new techniques, for mitigating adverse construction effects, should be sent to the Municipal Engineers Association".

TABLE OF CONTENTS

		PAGE
	Preface	(i)
	Table of Contents	(iv)
	Introduction	(v)
1.0	Communications and Information to Occupants	1
2.0	Working Area Delineation	2
3.0	Construction Workyards and Access Points	3
4.0	Equipment Fueling, Maintenance and Storage	5
5.0	Mud, Dust and Particulate Control	7
6.0	Noise and Vibration Control	8
7.0	Drilling and Blasting	10
8.0	Protection of Land Features and Vegetation	11
9.0	Clearing Rights-of-Way/Disposal of Excess Material	13
10.0	Site Drainage and Erosion Control	15
11.0	Dewatering	16
12.0	Groundwater and Wells	18
13.0	Water Crossings and Construction Through Sensitive Areas	19
14.0	Hydrostatic Testing and Disinfection	24
15.0	Site Restoration	25
16.0	Project Monitoring and Inspection	26
	Appendix X - Discharge of Chlorinated Water	28

INTRODUCTION

These guidelines will provide assistance to municipalities in planning the detailed design and construction of Municipal Road Projects, and Municipal Sewage and Water Projects. They are resource material, their use is voluntary, and they are not connected with the Class Environmental Assessment approval for Municipal Road Projects and Municipal Sewer and Water Projects.

The guidelines recommend construction procedures, which, are considered to be sound environmental practice. However, provisions to mitigate or reduce environmental effects are not without cost, therefore, what is technically desirable may not be practical in terms of cost benefit. In such cases, the applicability of the guidelines will have to be assessed by the proponent.

The proponent should be aware that from a construction administration viewpoint, mitigating procedures must be specific, practical in execution, and possible to cost and price by the contractor. Vague or motherhood statements in the specifications result in provisions being difficult to enforce, being ignored, or being overpriced because the contractor is uncertain of what is expected of him.

This document is a guide that should be read in conjunction with environmental considerations contained in other documents, and should be recognized as applicable in most situations.

1.0 Communications & Information to Occupants

During the design phase of the project and prior to implementation, opportunities for public involvement, be it through general advertising, information centres, or other similar methods, should be considered. Chapter 5 of the Class Environmental Assessments for Municipal Sewage and Water Projects and for Municipal Road Projects sets out details for this.

1.1 Additionally, the proponent, or its agent, when performing work on a municipal R.O.W., easement, or freehold, should inform residents in the area when and how they will be affected. General notification through the use of signs, newspaper notices, or notices placed in public places may be considered for the "Public" at large. For residents directly affected, specific detailed contact, through hand delivered flyers, or letters is desirable. Such letters would be sent out a suitable period prior to commencement of construction and should contain the following:

- Introductory remarks, indicating why the project is necessary
- Location of project, indicating limits of construction
- Type of work to be carried out
- Municipal contact person with phone number
- Consultants' contact person with phone number
- Contractor's contact persons with phone number
- An indication of the future direct contact the resident can expect relating to property access, interruption to utilities and services, etc.

Where direct contact is made, the Council and staff of the municipality in which the work is being carried out, should be provided with similar information.

2.0 Working Area Delineation

Prior to construction, certain areas within the project limits should be delineated, through the use of stakes, snow fencing, farm fencing or hoarding. Such delineation would be placed between the construction area and features identified for protection, such as watercourses, marshes, sensitive areas, trees and shrubs, to protect them from construction activities and equipment.

3.0 Construction Workyard and Access Routes

3.1 All equipment and materials should be stored in an orderly manner and in locations acceptable to the municipality.

Temporary workyards may be required to serve as sites for the storage of material and equipment, maintenance, miscellaneous work operations, employee parking, and field administration centres.

The amount of land cleared to establish a construction yard, additional working area, or access route(s) should be kept to a minimum. Workyards should be as close as possible to main roads for delivery of materials and equipment. Location and design of workyards and access roads should consider present and future land uses.

Workyards will not be located in environmentally sensitive areas, however, where there is no practical option, protective measures, as required by the municipality, must be taken.

In cases where the contractor arranges a lease for the establishment of temporary workyards or access roads, the restoration will be subject to the terms and conditions of the agreement between he and the lessor. The contractor should obtain from the landowner(s) of the areas to be used, a written agreement setting out terms, or any waivers or leases arranged for access roads and work areas. This agreement should be submitted to the municipality prior to the utilization of access roads or work areas. Upon termination of the use of the leased land, a release from the property owner will be provided by the contractor to the municipality.

3.2 Adequate access routes at appropriate locations must be available to cross the right-of-way/easement or temporary work area during all phases of construction so as not to inhibit movement of equipment or animals in an agricultural setting, or people and vehicles in an urban setting. Trenches to be left open for an extended length of time should be fenced, and/or signed to prevent access by the public, livestock, and other domestic animals.

3.3 For safety, public access to the construction yard must be restricted through the use of hoarding, a barrier, or a locked entrance gate.

3.4 The site should not constitute a traffic hazard created by incoming and outgoing vehicles. Warning signs should be erected at all approaches to construction areas. Intersections of access roads to construction sites should be identified to warn traffic of slow moving equipment, which may be turning on or off main roads. Access roads should be designed to accommodate anticipated loads and types of vehicles which are necessary for construction activities.

3.5 Protection of public road surfaces should be provided where construction equipment is utilizing these facilities, and any damage should be repaired to the satisfaction of the road authority.

4.0 Equipment Fueling, Maintenance and Storage

4.1 Equipment fueling, maintenance and storage should be done in a manner such that no fuels, oils, chemicals, and other toxic materials can gain access to surface or ground water.

The contractor should provide a detailed plan for his proposed construction route such that access routes and fueling areas are providing in accordance with this principle. Fuel storage, refueling, and maintenance of equipment should not be undertaken in, or adjacent to watercourses. Suitable fueling and maintenance areas should be established, and all maintenance and fueling conducted in these areas. The locations of all such areas would be subject to approval by the municipality.

The exception to this fueling location requirement is unlicenced equipment which may be fueled at other than the designated fueling area. No fueling of equipment, however, should be carried out within thirty (30) metres of any watercourse, unless no alternative is available. Acceptable non-spill fueling provisions should be used in such cases.

4.2 Notwithstanding the requirements of "Spills" legislation, a contingency fuel plan should exist for the containment and rapid cleanup and disposal of spillages (land and/or water), and should be submitted to the municipality for review and approval prior to starting work. Materials required for cleanup of fuel spillages should be maintained in a readily accessible and usable state on site, and be capable of handling maximum volume of liquid which may be spilled.

4.3 Any spill must be immediately reported to the local MOE District Office as required by "Spills" legislation.

4.4 Small amounts of waste from equipment servicing and maintenance may be disposed of at a waste disposal site designated for disposal of such materials. Large amounts of waste or excess oil or fuel should either be brought to a collection system, saved for future use, or returned to the supplier.

Wherever disposal of toxic wastes is contemplated, the local MOE District Office shall be contacted for direction on disposal requirements.

4.5 The cleaning of equipment in streams and lakes and the emptying of fuel, lubricants and solvents into watercourses is prohibited.

4.6 Exhaust emissions from equipment should be minimized through effective machine maintenance.

5.0 Mud, Dust and Particulate Control

5.1 Dust control measures should be undertaken to prevent dust nuisances resulting from any phase of construction operation.

Public roadways should be kept clean and free of mud as much as practically possible.

Permitted dust control measures may include the application of calcium chloride, brine, or water. In general, the use of calcium chloride or brine should be minimized and restricted to vehicular rights-of-way.

5.2 Wood chips or gravel may be considered as a lasting solution to dust problems in small, heavy use areas such as turnouts and truck loading and dumping areas.

5.3 Dusty materials should be transported in covered haulage vehicles.

5.4 Temporary seeding (e.g. of stockpiles left for long periods) and restrictions on crop/vegetation removal in easements can be considered as dust control measures in certain situations.

6.0 Noise and Vibration Control

6.1 Noise levels should be controlled in accordance with local by-laws or requirements. Proponents may also wish to consult the MOE document, "Model Municipal Noise Control By-law, Final Report, August, 1978".

Construction activities involving loud noise and vibration in areas where significant or endangered wildlife has been identified, should be scheduled to avoid endangering such wildlife, particularly at critical points in their life cycle.

6.2 The construction work will normally be restricted to day shift, and in conformity with local requirements.

Should the scheduling of work be required contrary to this, the contractor should secure special permission from the local municipal Council or its designated authority.

If proper noise attenuation cannot be achieved, and special permission is granted, adjacent residents should be given prior notice of any noise disturbance.

6.3 All vehicles and equipment should be equipped with effective muffling devices and be operated in a fashion to minimize noise levels in the project area, and should comply with all applicable by-laws.

6.4 Notwithstanding Clause 6.3, noise attenuation devices (barriers) may be required around pumps, compressors, and other stationary sources of loud noise. For compressors and pumps operated beyond normal working hours, special measures for noise attenuation should be considered.

6.5 The routes used for truck traffic related to the construction should be approved by the municipality. Truck traffic should not be directed through quiet zones or residential areas unless no alternative exists.

6.6 Control of noise and vibration from blasting operations should be in accordance with Publication NPC-119, Blasting, as amended.

7.0 Drilling and Blasting

The designer should conduct a general survey to establish the location and condition of any structures in proximity to the blasting area.

7.1 Drilling and blasting operations carried out in the vicinity of populated areas, should be carried out during normal working hours. When it is necessary that such activities be undertaken outside normal working hours, and over extended periods of time, adjacent residents potentially affected should be given prior notice.

7.2 Drilling and blasting operations should be scheduled only after notification to local authorities and the residents likely to be affected.

7.3 Measures to control dust associated with blasting should be instituted to minimize air pollution.

7.4 Blasting should be undertaken in such a manner as to minimize the effects on local wells and streamflow. Whenever possible, quantity and quality of water in wells within 300m from the proposed blasting should be monitored prior to blasting. See Section 12.1 for further details.

7.5 For control of noise and vibrations from blasting operations refer to Clause 6.6.

8.0 Protection of Land Features and Vegetation

A detailed inventory of vegetation which is endangered, protected, or important in the area of the project is an important tool in determining the value of the vegetation and appropriate mitigation procedures.

In rural woodlands and valley lands, a general inventory includes species composition, tree diameter at breast height (DBH), tree height, drainage and a general description with comments on the susceptibility of vegetation to construction related impacts.

In urban and environmentally sensitive areas, where the preservation of specific trees is important, a tree inventory should identify individual specimens and record species, tree diameter (DBH), tree height, condition and requirements for preservation.

Techniques for achieving protection of land features should appear in the construction specifications and drawings. The following sections summarize appropriate techniques for protection.

8.1 For vegetation to be protected in situ, the following provisions may be appropriate:

- Erect snow fencing around drip line of trees within working area;
- Do not stockpile material within drip line;
- Do not allow traffic, vehicles or equipment to compact soil within drip line;
- Prune interfering branches and treat with approved dressing;
- Preprune a year in advance of construction;
- Do not cut major tree roots;
- Tunnel under or around roots by hand digging so as to minimize damage to them;
- Treat any damaged roots over 25mm in diameter, immediately, with approved tree paint.

8.2 When raising grades in the vicinity of vegetation to be protected, the following provisions may be appropriate:

- When fill is less than 400mm deep, place clean washed gravel approximately 50mm in size around tree trunk to a minimum radius of 450mm;

- Place gravel before earth fill;

- Do not leave earth fill in contact with trunks;

- When fill is more than 400mm deep, depending upon the circumstances, the vegetation could be removed and replanted to match finished grade, a well could be formed around the trunks of trees using steel, wood, brick or stone retaining structures, and/or a watering/feeding/ventilation system could be established during filling operations utilizing tiles.

8.3 When lowering grades in the vicinity of vegetation to be protected, the following provisions may be appropriate:

- Provide broad rounded mounds for trees to be preserved and located above finished grade;

- Minimize the amount of cutting within drip line. This may involve leaving irregularly shaped mounds.

- Cut all exposed or broken roots greater than 25mm diameter clean, treat with approved dressing, and cover with top soil.

8.4 Transplanting vegetation requires proper planning and detailed specifications to ensure a reasonable rate of survival. Specifications should include the following items - root ball size, planting pit size, soil mixtures, staking and guying, pruning, mulching, fertilizing, moisture loss retardants and root and crown pruning in advance of transplanting.

9.0 Clearing Rights-of-Way/Disposal of Excess Material

9.1 Where practical, clearing and grubbing should be kept to a minimum, and should proceed only slightly in advance of construction.

Where practical, grubbing and topsoil stripping should not occur on any slopes or soils where soils may be sensitive to erosion (especially where the slopes are adjacent to watercourses) more than two days of production in advance of trench excavation.

9.2 Topsoil stripping, storage and restoration procedures should be specified on the basis of soil surveys and the intended end use of the site.

In locations where topsoil preservation is required, e.g. agricultural and natural lands, the topsoil should not be stripped in a wet or frozen condition. Topsoil and subsoil should be piled separately to avoid mixing. Restoration procedures should consider chisel ploughing, subsoiling, fertilizing, heavy mulching and the use of soil building cover crops.

A monitoring program of soil nutrients, organic matter, and density/compaction may be necessary to determine the condition of restored soils in selected areas.

Stockpiled material should be located away from watercourses and be stabilized to prevent erosion. Where such measures are necessary and siltation of watercourses is possible, straw bale containment devices, perimeter ditching or contour ploughing should be employed to prevent soil erosion.

9.3 All cleared, grubbed, and excavated material should be disposed of in accordance with the procedures described in the sections which follow. At no time should excess fill be disposed of in watercourses, drainage ditches, or floodplain areas without the permission of the appropriate authority having jurisdiction (e.g. local Conservation Authority, Ministry of Natural Resources or municipality).

9.4 Excess excavated material, stones, construction debris, cleared vegetation, should be disposed of in a manner acceptable to the municipality.

Wherever possible, first option of spoil material should be made available to the landowner or the municipality.

Arrangements for other disposal sites should be made by the contractor if the municipality or the landowner cannot make use of the surplus excavated materials.

Cleared vegetation should be chipped or burned. It may also be stacked along the right-of-way for wildlife habitat enhancement. Body wood should be cut in appropriate lengths and stacked along the right-of-way.

9.5 The contractor should obtain from the landowner(s) of areas to be used for disposal a written agreement setting out terms, conditions, and ultimate responsibility for the materials to be disposed and locations for disposal. This agreement should be submitted to the municipality prior to utilization of the site.

10.0 Site Drainage and Erosion Control

10.1 To prevent runoff water from draining into the excavation, proper site grading is advisable.

10.2 Removal of vegetation from slopes and near watercourses should be minimized. Ten metre (minimum) vegetation strips between the construction right-of-way and watercourses should be maintained until trenching and pipe laying are imminent. This area should be extended to the tops of any adjacent slopes where there is potential for erosion of soils to watercourses. Such areas should be designated on the contract drawings.

10.3 Provision should be made to intercept and divert site drainage, at short distance intervals, into natural channels, infiltration ditches, settling ponds, or areas of suitable and stable ground cover.

10.4 Settlement ponds or impoundment facilities are desirable, in areas such as:

- at locations where the excavation of well points using water jets will produce large quantities of turbid water;
- at stream crossing locations where extensive dewatering is anticipated;
- at locations where oil contaminated water may be pumped from tunnel excavations.

In such cases, appropriate sedimentation/retention measures should be provided to ensure that sediment discharge to watercourses or adjacent land is minimized.

In special cases, contact should be made with the local offices of MOE and MNR, and/or local Conservation Authorities or drainage authorities to discuss sedimentation avoidance and/or retention measures.

11.0 Dewatering

Dewatering is the removal of impounded or ground water from the construction area. As a result of exposure to various soils and construction materials, such impounded water may have high concentrations of suspended sediment or may be contaminated with high nutrient content and/or substances harmful to the receiving waters. If such substances are involved, the Ministry of the Environment should be contacted and provided with information relating to the contaminants, concentrations, and the proposed method of handling these materials.

To prevent such water from affecting the water quality of watercourses, techniques described in the following should be used.

11.1 Suspended solids should be settled prior to such water being pumped out of an impoundment. Settled solids (silt) may be removed, if necessary, after water has been pumped out and disposed of at an approved location.

11.2 If time does not allow for suitable settling of turbid waters within the impoundment, water should pass through a sediment barrier. For small scale operations, this can be achieved by pumping the water onto a suitable, stable cover area and allowing for infiltration of sediment through the ground cover. Berms of straw bales or other suitable materials may be used to slow runoff and encourage infiltration. These forms of sediment barriers should be checked periodically and replaced when they become saturated with silt. Larger scale operations may require special designs.

11.3 When continuous pumping of turbid water is undertaken, it may be necessary to construct a sediment basin through which the water can be passed. A splash pad where the pumped water is discharged will assist in reducing surface erosion.

11.4 Discharge from dewatering operations to existing storm sewage works should be allowed only if the discharge meets the requirements of the "Municipal Sewer By-law".

11.5 If the water removed during a dewatering operation is greater than 50,000 litres per day from any ground water source, a water taking permit, issued under the Ontario Water Resources Act, must be obtained by the contractor from the Regional Office of the Ministry of the Environment. Prior to issuance of the permit, sufficient lead time is required to discuss any possible impact with water taking and discharge, and possible conditions which may apply to the permit.

12.0 Groundwater and Wells

12.1 A water level and water quality survey of wells in the zone of influence of trenching operations should be carried out during final design and be monitored during construction. The condition of existing wells should be documented prior to commencing construction. Observation wells for recording changes in quantity/quality may be established using existing wells or drilling new shafts where potential problems could arise. It may be desirable to monitor wells at least one season prior to construction and secure well records where they exist.

12.2 A contingency plan should be established prior to commencement of construction to minimize inconvenience, should it be necessary to provide water for the occupant.

12.3 Occupants experiencing temporary interference should have water made available to them until groundwater conditions return to normal or service is reinstated.

Occupants experiencing permanent interference should have their water wells or supply services restored (e.g. new well or an extension of municipal service).

13.0 Water Crossings and Construction Through Sensitive Areas

In the design phase, the following should be considered:

- timing of construction should avoid interference with fish migration, spawning or egg incubation;
- there should be no blasting in or adjacent to watercourse beds during fish migration, spawning or egg incubation. Devices such as air curtains may be required to minimize the impact of blasting in water bodies at other times;
- construction operations should be timed to avoid recreational lakes or rivers during peak-use periods.

Detailed contract specifications and drawings for each significant stream crossing, intake or outfall, and sensitive area should be included as part of the general specifications and drawings, and submitted to the Ministries of the Environment, Natural Resources, and the local Conservation Authorities for review. Other parties may be included if required. The contract documents should reflect any restrictions imposed on the scheduling and/or methods of construction.

The contractor should submit to the municipality prior to construction, his detailed procedures and schedule for review. The municipality should consult with the appropriate authorities if there is any question of compliance of the proposed procedures and schedule with the contract documents. The contractor should not be allowed to proceed without the written approval of the municipality.

The municipality should forward to the nearest offices of the Ministries of Natural Resources, and Environment, and the local Conservation Authority, the following information:

- the date that construction is anticipated to start, together with the proposed schedule of construction activity, including mitigative and site restoration activities;
- periodic reports on construction progress if required;

- notice two (2) days prior to initiation of work in water crossings, watercourses, and other sensitive areas identified by the above-referenced agencies.

Guidelines as described in the following should be incorporated into the contract documents where applicable.

13.1 Before construction at the watercourse crossing begins, all equipment and materials required to permit an expeditious crossing should be on site and ready for use. Stream crossings should be carried out only when there is a reasonable expectation that weather conditions will be favourable.

The time from excavation to restoration should be kept to a minimum.

Maximum construction times for all elements of the work within the stream crossing and floodplain should be detailed in the contractor's schedule and procedures.

13.2 The locations at which vehicles and heavy equipment may cross the stream should be identified in the specifications. (Vehicle crossing restrictions should be stated to the greatest extent possible.) At no time should the stream bed be used as a vehicle or equipment route except for those crossings specified. Crossing should be as perpendicular to the stream as possible to minimize in-stream disturbances.

Vehicles may ford streams if water levels are low enough and if the streambanks and beds are composed of erosion resistant material. The use of wooden, rubber, or gabion mats is encouraged to protect the stream banks. Where the fording areas and banks are prone to erosion, suitable stabilization will be required before use of this crossing, to minimize stream muddying. Transport of equipment around watercourse via local roads should be considered as an alternative to the construction of new access crossings.

13.3 Bridging or fording installations for temporary stream crossings should be made on existing natural grade where possible, with minimum disturbance to the channel. These installations should be protected by erosion resistant materials, e.g. sandbags.

13.4 Materials excavated from the watercourse should be removed and disposed of in a manner to ensure minimum possible siltation to the watercourse.

13.5 The removal of vegetation from the right-of-way should be kept to the minimum width for construction.

13.6 Aquatic weeds uprooted or cut prior to, or during construction operations, should be contained and adequately disposed of on land.

13.7 If a diversion channel is required, it should be suitably sized and stabilized before the stream is diverted. Potential erosion sites in any emergency spillway, drainage or diversion channel, should be protected with rip rap, sand bags, or other resistant material.

A water-taking permit from the MOE (Regional Office) is required prior to the construction of a stream diversion channel or temporary coffer-dam for purposes of water storage. The permit requires that adequate downstream flow be maintained at all times to ensure the satisfactory continuation of downstream water uses, and to ensure the preservation of plant and animal life in the stream channel.

13.8 Temporary coffer-dams and diversion channels should be designed to withstand any short-term or seasonal floods. The necessary equipment and materials should be readily available for remedial work to any dams in the event of an emergency situation. Stable material such as coarse gravel, broken rock, and sand bags is preferred over loose sand, loams and organic soils in the construction of such dams. Erodible material on the sides of the coffer dams should be protected against current action with rip rap, sand bags, or other protective material.

13.9 During design of major water crossings, an analysis of the characteristics of stream bed soils (to the maximum expected depth of trench) should be undertaken. The purpose of this analysis is to allow:

a) predetermination of acceptable construction techniques to be employed;

b) predetermination of acceptability of the excavated materials for backfill. This analysis may include:
   - excavated material types and volumes (clay, silt, etc.)
   - particle size and volumes;
   - contaminants such as PCB, mercury, high nutrient content, etc.

Excavated materials from the bed of the watercourses not suitable for backfilling the trench should be removed and deposited on land.

Disposal locations and methods for storing spoil material containing contaminants should be identified in the contract specifications and drawings. The run-off from such spoil should not be allowed to re-enter the surface waters. Ditches or berms may be constructed to prevent run-off. Locations where use of this technique is not possible should be identified. The same or similar procedure will have to be followed during the preparation of contract documents for intakes and outfalls.

13.10 Clean material should be used to cover the pipe as soon as it is laid across the watercourse and the streambed protected from erosion.

Streambanks and beds that have been disturbed during construction should be stabilized immediately after construction to prevent erosion.

In the event a "by-pass" or "dry" construction technique is used, beds and banks of streams should be reinstated and stabilized prior to removal of temporary installations.

13.11 In sensitive areas, cut-off walls, subsurface berms or trench plugs should be used to prevent the creation of a "french drain effect" in the trench.

14.0 Hydrostatic Testing and Disinfection

For the purpose of hydrostatic pressure testing of sections of newly constructed water/sewage works, the taking of water from surface or ground sources in excess of 50,000 litres per day must be authorized by a water-taking permit issued under the Ontario Water Resources Act. Applications are available through the respective Regional Offices of the Ministry of the Environment and must be submitted at least six weeks in advance of any hydrostatic test.

14.1 The terms and conditions of a permit require that the filling of the pipeline from surface sources be carried out in such a manner that stream flow is not stopped or reduced to a rate that will interfere with downstream uses or with the natural functions of the stream. For proposed takings from sources in low-flow stages, the issuance of a permit may be refused until a period of higher flow, or the proposed rate of taking may be proportionally reduced as required.

Hydrologic studies may be required to determine whether sufficient water will be available from local watercourses, and to recommend alternative water supplies, if necessary.

14.2 The discharge of water from water/sewage works should conform to the following:

a) The linear velocity of discharge should not produce scouring of the stream channel or lake bed. A splash pad installed at the discharge will help to prevent erosion.

b) The quality of water returned to the watercourse or lake should be substantially the same as the water withdrawn.

c) The discharge of chlorinated water shall be in accordance with Schedule "X" attached hereto.

15.0 Site Restoration

15.1 Restoration of the construction area should return the property to a condition at least equivalent to the state of the land prior to construction. Any special conditions affecting the land should be negotiated with the property owner at the time the option is obtained and be included in the contract documents.

Studies of appropriate seeding and planting may be required to ensure a rapid recovery of construction areas to the pre-construction state.

15.2 Restoration should follow construction immediately, if feasible. When it is not practical to carry out full restoration, interim measures should be provided.

15.3 All surface features damaged during construction or designated to be replaced should be restored as nearly as possible to original condition.

15.4 Discussions with appropriate parties should be entered into by the Engineer during the design phase so that the extent and location of tile drainage systems can be determined.

16.0 Project Monitoring & Inspection

Projects should be monitored and field inspected to some degree for two reasons:

1. To ensure compliance with contractual agreements dealing with the environmental construction practices specified for projects; and,

2. To assess the overall performance and effectiveness of the required environmental construction mitigation practices in the field.

Documentation of project monitoring and field inspection may be specifically required in an Environmental Study Report (ESR) for those projects prepared under the Class E.A. for Municipal Roads and Municipal Sewage and Water Projects. For those projects not governed by an ESR, it would still be useful to document such findings for future reference.

In general, project monitoring and field inspection provide an accounting and control mechanism for proponents, consultants, contractors, Government agencies and the public to learn from successes and failures associated with the implementation of the undertaking. These activities should ensure that there is a direct feedback to permit comparison of what is actually experienced in the field to what was predicted in the project planning stage. This allows environmental impact predictions to be re-evaluated and improved from project to project. Also, unexpected and longer term impacts that occur during a project's implementation can be identified and action taken to mitigate future negative effects.

The general contents of a project monitoring and field inspection report designed to assess the performance of certain construction practices would include the following:

- A definition of the objectives of a monitoring and inspection program;

- A clear indication of the predicted key impacts that are to be monitored during, and immediately following construction;

- An outline of the information required to assess the effectiveness of the mitigating environmental construction measures selected. This could include the frequency and timing of surveys for various environmental parameters, location of monitoring sites, methods of data collection, analysis and evaluation;

- The date of completion of the documentation;

- Summary of major findings.

For major projects that may have significant environmental effects, such as large projects with significant watercourse crossings, it may be important to retain an environmental inspector to assist the engineer in his responsibilities. This would help to ensure that the environmental mitigation measures, as outlined in the contract documents, are followed by the contractor. In most instances, the environmental inspector could also be responsible for the preparation of the monitoring documentation."

APPENDIX "X"

8.0 Discharge of Chlorinated Water

Chlorinated water, as used in the disinfection of watermains and reservoirs, can be very toxic to aquatic organisms and it should not be disposed of without careful thought to its effect on the receiving water or sewage treatment plant (STP).

Chlorinated water can be discharged to:

a) Sanitary Sewers - This is a safe course to follow especially if the volume is not great and there is a considerable distance from the point of addition to the STP. However, if there is a large volume, e.g. with a reservoir, it is essential to contact the municipality to ensure that the operation of the STP is not adversely affected by a hydraulic overload or a massive slug of water with a high chlorine residual.

b) Receiving Waters - This can be detrimental to aquatic life and many fish kills have resulted. Water with a free chlorine residual should not be discharged to a stream or lake. If a combined chlorine residual is present, the concentration at the edge of the mixing zone (where allowed) should be below 0.002 mg/L.

c) Storm Sewer - This should be thought of as directly connected with the receiving water and the same restrictions should apply, even though there could be considerable dilution during wet weather.

d) Drainage Ditch - Discharge to an open ditch is a good alternative, especially if the point of addition is a considerable distance from the receiving water and the ditch is unlined and is full of weeds and other organic material. Sunlight and high temperatures would help to dissipate the chlorine quickly.

If the above conditions cannot be met, a slow discharge of the chlorinated water to a sanitary sewer or ditch can be used. This is easier and cheaper than dechlorination. If dechlorination is necessary (i.e. with direct discharge to a small stream), there are several chemicals that can be used effectively. Adequate mixing and dosage of the chemical with the chlorinated water must be ensured. The amount of dechlorination chemical required can easily be determined from the following equation.

Excess chlorine residual x Factor = Dechlorination chemical required.

This can be worked out in mg/L, lbs or whatever units are appropriate.

There are five chemicals that can be used to dechlorinate the water:

i) Hydrogen Peroxide - (Factor = 0.479) - This is probably the best chemical when discharging to an environmentally sensitive watercourse. It is cheap and an overdose will only add more oxygen to the stream.

ii) Sulphur Dioxide - (Factor = 0.901) - This chemical is cheap but it will slightly lower the ph in the receiving water.

iii) Sodium Thiosulphate - (Factor = 2.225) - This will cause some sulphur turbidity but an excess is harmless.

iv) Sodium Sulphite - (Factor = 1.775) - Excess will lower the dissolved oxygen in the stream.

v) Sodium Pyrosulphite - (Sodium Metabisulphite) - (Factor = 1.338) - Excess will lower the dissolved oxygen in the stream.

For example, a total chlorine residual of 21 mg/L measured in a disinfected watermain of 11,000 L (2400 gal.) for discharge at only 1 mg/L Cl_2 could be neutralized with hydrogen peroxide. The dosage required would be 20 mg/L x 0.479 = 9.6 mg/L and the total amount needed would be 9.6 x 11000 = 105.6 gm of H_2O_2. This would represent, in terms of 35% commercial grade hydrogen peroxide (sp. gr. 1.13 g/ml), $105.6 \times \frac{100}{35} \times \frac{1}{1.13}$ = 267 ml of concentrate.